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February 23, 2005

Subject: Conesville Unit 4 SO3 testing

From: Keith McDonald

To: Geoff Campbell

Sulfur Trioxide and sulfur dioxide concentrations were measured in the flue gas from Conesville Unit 4. The purpose of this test was to determine the SO_2 to SO_3 conversion rate of the furnace and the removal rate of SO_3 in the air heater. The distribution of SO_3 concentrations across the air heater outlet duct was also observed. The unit was operated at full load with ammonia fly ash conditioning turned off.

Methodology

The controlled condensation method and Barium Perchlorate/Thorin titration were used for all measurements. One sampling system was operated at the economizer outlet (A side) and three separate sampling systems were operated at the air heater outlet (A side). Four complete tests were performed during a two-day period. One complete test consisted of four separate runs at each sampling system. The results reported for each test are the average of the four separate runs. Any individual run that deviated from the average by more than 15% was assumed to be biased. Biased runs were rejected, and the average was re-calculated.

Results and Conclusion

The conversion rate averaged 1.41% on the first day and 1.5% on the second day. The air heater removal averaged 0% on the first day and 16% on the second day. For purposes of future planning strategies, a conversion rate of 1.5% and an air heater removal rate of 0% will be assumed.

The distribution in SO_3 concentrations across the air heater outlet duct is due to condensation on the cold side and re-evaporation in the middle and hot side. The SO_3 removal on the second day is likely due to lower ambient air temperatures. This caused the air heater outlet gas temperature to drop slightly, causing an increase in the SO_3 removal across the air heater.

The table below summarizes these results.

Conesville Unit 4 SO_3/SO_2 Concentrations				
Location	Ave. SO_3 @ 3% O_2 (ppm)	Ave. SO_2 @ 3% O_2 (ppm)	Conversion Rate (%)	Removal Rate (%)
Feburary 16, 2005, am				
Economizer Outlet	22	1478	1.45	-
Air Heater Outlet				
-West port	15	-	-	
-Middle port	27	-	-	
-East port	26	-	-	
Average	22			0
Feburary 16, 2005, pm				
Economizer Outlet	27	1976	1.37	-
Air Heater Outlet				
-West port	14	-	-	
-Middle port	27	-	-	
-East port	39	-	-	
Average	27			0
Feburary 17, 2005, am				
Economizer Outlet	31	1939	1.60	-
Air Heater Outlet				
-West port	12	-	-	
-Middle port	26	-	-	
-East port	36	-	-	
Average	25			21
Feburary 17, 2005, pm				
Economizer Outlet	28	1986	1.40	-
Air Heater Outlet				
-West port	13	-	-	
-Middle port	26	-	-	
-East port	34	-	-	
Average	25			12

Report Written by:

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Date

Cc: Aimee Toole

Intra-System

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February 2, 2006

Subject: Conesville Power Plant Unit 6– SO_3 Testing

From: Keith McDonald

To: Geoff Campbell

Cc: Mike Bright, Jeff White

Sulfur trioxide and sulfur dioxide concentrations have been measured in the flue gas at Conesville Power Plant Unit 6. The purpose of this testing was to determine the SO_2 to SO_3 conversion rate of the furnace, SO_3 removal rate and stratification across the air heater, and the combined SO_3 removal rate across the ESP and FGD.

Methodology

All SO_3 and SO_2 measurements were made using the Controlled Condensation Method. Conesville Unit 6 is equipped with single economizer outlet and air heater outlet ducts, and two FGD absorbers. Economizer outlet measurements were made from two ports located near the center of the duct, but about 15 feet apart to determine the extent of stratification. Air heater outlet measurements were made from three ports spanning the entire width of the duct, also to determine the extent of stratification. FGD outlet measurements were made from the top of the West absorber.

The conversion rates were determined by measuring SO_3 and SO_2 concentrations at the middle duct-middle port. SO_3 and SO_2 concentrations were corrected to 3% oxygen to account for air leakage in the flue gas ducts. Conversion rates were calculated by dividing the SO_3 concentration by the SO_2 concentration and are expressed as a percentage. The removal rates are expressed as a percentage loss of the concentration entering the device.

The Unit 6 remained at full load during all testing and burned a high sulfur eastern bituminous coal typical for the unit.

Results

The tables below and attached spreadsheets summarize results of measurements made at Conesville Plant.

Table 1 Conesville Unit 6 Summary of Data			
Date	**Economizer Outlet**	**Air Heater Outlet**	**FGD Absorber Outlet**
1-18-06 **Location** **Flue Gas Temp.** **Ave SO_3 / SO_2 (@ 3% O_2)**	West Port 744 °F 23 ppm / 2788 ppm	West Port 290 °F 12 ppm Middle Port 319 °F 20 ppm East Port 362 °F 25 ppm	West Absorber 123 °F 9.7 ppm
1-18-06 **Location** **Flue Gas Temp.** **Ave SO_3 / SO_2 (@ 3% O_2)**	East Port 737 °F 22 ppm / 2922 ppm		West Absorber 122 °F 9.8 ppm
1-18-06 **Average**	23 ppm / 2855	West side Ave. 16 ppm Overall Ave. 19 ppm	9.8 ppm
1-19-06 **Location** **Flue Gas Temp.** **Ave SO_3 / SO_2 (@ 3% O_2)**	West Port 738 °F 25 ppm / 3330 ppm	West Port 291 °F 17 ppm Middle Port 319 °F 20 ppm East Port 361 °F 27 ppm	West Absorber 122 °F 11 ppm
1-19-06 **Location** **Flue Gas Temp.** **Ave SO_3 / SO_2 (@ 3% O_2)**	East Port 700 °F 22 ppm / 2796 ppm		West Absorber 123 °F 11 ppm
1-19-06 **Average**	24 ppm / 3063	West side Ave. 18 ppm Overall Ave. 21 ppm	11 ppm

Table 2 Conesville Unit 6 Summary of Calculations			
Date	**Furnace Conv. Rate (% of SO2)**	**Air Heater Removal Rate (%)**	**ESP – FGD Removal Rate (%)**
1-18-06	0.8	-	-
1-18-06	0.8	17	39
1-19-06	0.8	-	-
1-19-06	0.8	13	39

Conclusion

The SO_2 and SO_3 concentrations have been measured at Conesville Unit 6. From these concentrations, the furnace conversion rate, air heater removal rate, and the ESP-FGD removal rate were determined.

The furnace conversion rate ranged from 0.75 to 0.82%, averaging about 0.8%. This conversion rate was lower than the 0.9% previously measured at Conesville Unit 5, an identical unit burning the same coal. It should be noted that Unit 6 underwent extensive de-slagging operations approximately two to three weeks prior to this testing. Previous experience has demonstrated that the furnace conversion rate decreases for a period of time following de-slagging. This may explain the lower conversion rate. If additional slag forms in the furnace of Unit 6 over time, the conversion rate may increase to approximately 0.9%.

The furnace conversion rate did not vary significantly across the economizer outlet duct, but the SO_3, SO_2, and flue gas temperature did vary somewhat. The flue gas temperatures also deviated from the control room indicator by about 40 to 50 degrees F. These variations may be due to the duct orientation and flue gas stratification as it exits the economizer.

The air heater removal rate ranged from 13 to 17%. These measured removal rates varied because the ambient temperature increased from 35°F on the first day to 60°F on the second day. An increase in ambient temperature will make the air heater plates warmer when they enter the flue gas and less SO_3 condensation will occur.

It was also observed that the air heater outlet middle port SO_3 concentration was within 1 ppm (5%) from the overall average. If additional testing is needed at this location in the future, the middle port appears to be representative of the entire duct, and testing at multiple ports may not be necessary.

The ESP-FGD removal rate was 39%. It should be noted that SO_3 was measured only on the West absorber. Therefore, only the West and Middle air heater outlet port results were averaged and compared to the absorber results. The East ESP-FGD absorber would likely yield a similar removal rate; however the SO_3 concentration would be higher since the East side of the air heater outlet had higher concentrations.

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2-2-06
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Appendix A

Data Sheets

Data sheets not found.
Data is summarized in report, Table 1.
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